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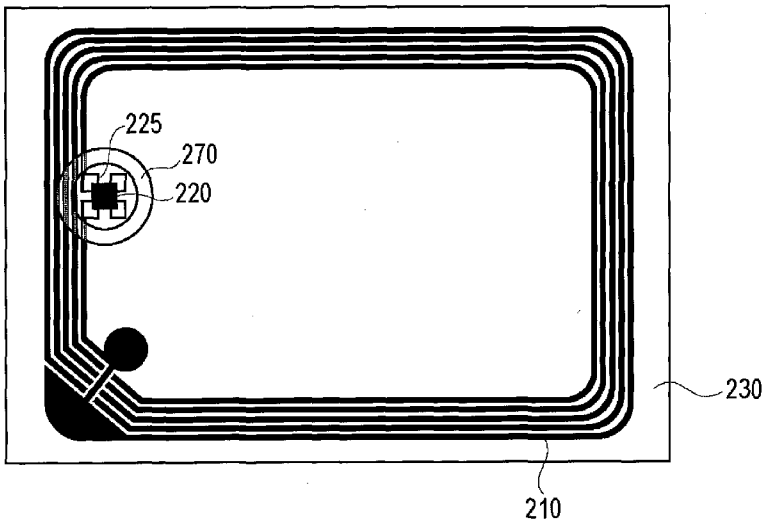
(54) Title: FLEXIBLE RFID LABEL WITH FLEXIBILITY CONTROL APPARATUS

[Fig. 5]



200

(57) Abstract: A flexible RFID label is adapted to be attached to an object of flexible structure. The flexible RFID label comprises an RFID inlay having a flexible film-shaped substrate 230, an antenna disposed on the flexible film shaped substrate 210, and an integrated circuit (IC) chip electrically connected to the antenna. An adhesive layer is adapted to attach the RFID inlay to the object of flexible structure. At least one flexibility control apparatus is utilized having a solid layer adapted to engage with the RFID inlay. The solid layer is positioned to align with the IC chip and dimensioned such that the IC chip is within an outer periphery of the solid layer when viewed perpendicular to the surface of the substrate.

[DESCRIPTION]

[Title of Invention]

FLEXIBLE RFID LABEL WITH FLEXIBILITY CONTROL APPARATUS

[TECHNICAL FIELD]

[0001]

The present invention relates to a flexible RFID label and in particular an RFID label that contains a flexibility control apparatus that controls the manipulation of the RFID label.

[BACKGROUND ART]

[0002]

The use of Radio-Frequency Identification (RFID) technology has become pervasive in many fields and is used in many capacities beyond the tech industry. RFID technology in particular has become widely used in the medical device industry, such as for managing inventory and tracking items. In this capacity, an RFID system may be utilized to track medical items with several components or medical items that are require information to be conveyed. A typical RFID system including one or more RFID tags or labels, used interchangeably herein, that are attached to a particular product, e.g., a medical device, and at least one RFID reader or transponder that detects the RFID labels. RFID readers will transmit and receive information to and from the RFID tags; to do so, a reader will generally include a control unit that manages the reading of RFID tags and an antenna that communicates with an individual RFID tag.

[0003]

In general, a conventional RFID label structure will be formed as a

laminate of different functional components. As part of an RFID inlay of an RFID label, a loop antenna is attached to a substrate to form the antenna portion of the RFID label. The loop antenna is connected electrically to an integrated circuit (IC) chip that will drive and control the broadcast of the RFID tag. The RFID tag may have a component that can adhere to a surface, using tape or other forms of adhesive. Attachment of RFID labels to particular products will allow them to be detected by a reader RFID system when the products come within a certain distance of the reader RFID system.

[SUMMARY OF INVENTION]

[TECHNICAL PROBLEM]

[0004]

It becomes an important requirement that the laminated components of an RFID label are maintained in their operable state so that an RFID reader to accurately receive information contained within the RFID label.

[0005]

In general, a conventional RFID label will be formed as a laminate of different components. FIG. 1 illustrates an RFID inlay 100 of a conventional RFID label where a loop antenna 110 (or antenna 110) is attached to a substrate 130 to form an antenna portion of the RFID label. The loop antenna is normally formed by etching, e.g., a thin metal layer. The substrate 130 is typically a flexible-film shaped substrate formed from a flexible polymer-based material such as plastic. The present invention realizes the substrate made from Polyethylene terephthalate (herein known by its abbreviation "PET").

The loop antenna 110 is electrically connected to an integrated circuit (IC) chip 120, which drives and controls the broadcast of the RFID label, at a connection point 125.

[0006]

FIG. 2 shows a system 190 wherein an RFID label 180 is attached to a product 160, e.g., a medical device blood bag. RFID labels like the aforementioned typically include a top cover 140 that may include a visual adhesive label 148 on the outer surface of the RFID label 180. The adhesive label 148 conveys information about the product. Information may be conveyed with text (as text information 142), or with a coded system such as a barcode or QR code (coded information 141). This same information on the adhesive label 148 of the top cover 140 of the RFID label 180 may also be contained electronically via an IC chip of the RFID label 180. Thus, a reader RFID system will be able to electronically detect such information.

[0007]

For illustration of how the RFID label 180 is conventionally laminated, FIG. 3A and FIG. 3B show a cross-section of a RFID label with components. The RFID label 180 is exhibited to include block components so as to be illustrative only, and it can be appreciated by those skilled in the art that the components of the RFID label 180 may have different dimensions and properties, e.g., thickness, shape, etc., than the components illustrated herein. It can be further appreciated by those skilled in the art that layers of the components of an RFID inlay 100 and RFID label 180 of the embodiments may be switched to form a different laminate.

[0008]

As shown in FIG. 2, the RFID label 180 may be applied to the surface of a product 160. From FIG. 3A and FIG. 3B, the directionality of the components of the RFID label 180 is illustrated from a "top-down" cross-sectional view. The directionality of "top," "up," or "over" and "bottom," "down," or "under" is made with respect to the orientation of the application of the RFID label 180 onto the surface of the product 160.

[0009]

The top surface of the RFID label 180 consists of a top cover 140. The top cover 140 may include of the adhesive label 148, the underside of which being an adhesive layer 150b that attaches the top cover 140 to an RFID inlay 100, as shown in FIG. 3A. Alternatively, in FIG. 3B, the top cover 140 may also include a cover film 135 of polymer-based material, e.g., PET, that will be formed as a laminate of the RFID inlay 100.

[0010]

The RFID inlay 100 of the RFID label comprises an IC chip 120 attached to an antenna 110, e.g., a loop antenna, at a connection point 125. The antenna 110 is placed on a substrate 130 made of a polymer-based material or the like. An RFID inlay 100 may have a component that allows adhesion to a surface, such as tape or another form of adhesive. An adhesive layer 150a attaches to the bottom of the substrate 130 of the RFID inlay 100 so as to be applied to a product 160.

[0011]

The present invention illustrates a "chip up" RFID inlay, where the

IC chip 120 is located on a layer "above" or "up from" the antenna 110 and substrate 130. The present invention may also be realized as a "chip down" system, where the IC chip 120 is located on a layer "below" or "down from" the antenna 110 and substrate 130. For ease of illustration, and unless otherwise stated, the present embodiments are illustrated to use a "chip up" system.

[0012]

As the antenna 110 of the RFID inlay 100 is made of a metal that is thin, and the substrate 130 is made from a flexible polymer-based material, both layers of the RFID label 100 will allow flexible movement when attached with adhesive 150b to the surface of a product 160. As it can be imagined, in the conventional RFID inlay 100, a product with a flat surface will allow advantageous resting conditions of the IC chip 120 attached to the antenna 110 since the aforementioned allows little warping of the shape of the antenna 110 and the substrate 130. The components of the RFID label 180 will not be detrimentally affected in the case where an RFID label is attached to a product whose surface does not undergo extensive manipulation or to a product that does not undergo a state change. Products that have flat surfaces and those that are not moved around or subject to any impact have been considered ideal surfaces for typical RFID labels and RFID label systems.

[0013]

However, with the increased use of RFID labels in the medical device industry, it is understood that, by way of the medical devices to which they are attached, the RFID labels are subject to heavy manipulation

and impact stress. In the case of a blood bag, for example, the size of a bag expands to fit any variety of contents, occasionally making the surface of the product not flat. Further, a blood bag itself must be folded at least once to fit inside a centrifuge. When the blood bag undergoes a tremendous amount of pressure, such as in a centrifuge, its contents are pushed to one particular side. At least these aforementioned manipulations occur to a product, and it becomes important for the RFID inlay 100 of the RFID label 180 to maintain its working functions under particular conditions.

[0014]

However, if a flexible product such as the illustrated blood bag is manipulated as above, the antenna 110 and substrate 130 will necessarily move with the blood bag. FIG. 4 shows an illustrated view of the condition when the antenna 110 of a RFID inlay 100 is manipulated. Because the IC chip 120 is made of a hard material, the IC chip 120 cannot bend with the antenna 110 upon application of a force (vertical force Fv or horizontal force Fh). As a result, the connection at connection point 125 and beyond of the IC chip 120 to the antenna 110 may become weakened, resulting in read errors of the RFID inlay 100 of the RFID label 180. This problem has been found to occur in the conditions of heavy bending, such as described above with respect to the manipulations of a blood bag.

[SOLUTION TO PROBLEM]

[0015]

The present invention addresses at least the above disadvantage, and a general purpose of an embodiment of the invention is to provide an

RFID label 180 with an RFID inlay 100 that can maintain a strong connection between the IC chip 120 and the antenna 110 in the case of heavy manipulation of the surface of the product 160 on which the RFID label 180 is attached. According to one embodiment of the invention, an RFID label may be realized that controls the flexibility of the RFID inlay such that the connection between an antenna and an IC chip is properly maintained. A flexibility control apparatus is attached to the RFID inlay, allowing for controlled manipulation of the RFID label.

[0016]

Another embodiment of the present invention is to provide further flexibility and support to an RFID label with a flexibility control apparatus. An annular flexibility control apparatus is attached to the RFID inlay to give further support to the IC chip.

[0017]

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and described herein, a flexible RFID label is provided that is adapted to be attached to an object of flexible structure. The flexible RFID label comprises an RFID inlay having a flexible film-shaped substrate, an antenna disposed on the flexible film shaped substrate, and an integrated circuit (IC) chip electrically connected to the antenna. An adhesive layer is part of the flexible RFID label, adapted to attach the RFID inlay to an object of flexible structure. At least one flexibility control apparatus having a solid layer is adapted to engage with the RFID inlay, wherein the solid layer is positioned to align with the

IC chip and dimensioned such that the IC chip is within an outer periphery of the solid layer when viewed perpendicular to the surface of the substrate.

[0018]

In addition, the flexibility control apparatus may contain one or more adhesive layers that attach to the RFID inlay and/or the product. The flexibility control apparatus may be of a solid form, or may be in an annular form, with an aperture formed in the middle thereof.

[0019]

Further, the flexibility control apparatus may be realized to engage with a "chip up" or "chip down" solution of an RFID label.

[0020]

The flexible RFID label may be formed as part of a product, including the tracked medical device or as part of the RFID reader system, and the product may be implemented as a portable product.

[0021]

Optional combinations of the aforementioned constituting elements and implementations of the invention in the form of methods, apparatuses, or systems may also be practiced as additional modes of the present invention.

[ADVANTAGEOUS EFFECTS OF INVENTION]

[0022]

According to the present invention, a more secure and flexible RFID label may be realized with strengthened RFID inlay connection.

[BRIEF DESCRIPTION OF DRAWINGS]

[0023]

Embodiments will now be described, by way of example only, with reference to the accompanying drawings, which are meant to be exemplary, not limiting, and wherein like elements are numbered alike in several Figures, in which:

[FIG. 1]

FIG. 1 is a top view of a conventional RFID inlay with an antenna and IC chip;

[FIG. 2]

FIG. 2 is an illustrative view of an RFID label attached to a medical device;

[FIG. 3A]

FIG. 3A is a cross-sectional view of an RFID label system including an RFID inlay and top cover;

[FIG. 3B]

FIG. 3B is a cross-sectional view of an RFID label system including an RFID inlay and top cover as in FIG. 3A, with an additional cover film;

[FIG. 4]

FIG. 4 is an illustrative view of force applied to the RFID inlay during manipulation of a flexible product;

[FIG. 5]

FIG. 5 is a top view of an RFID inlay with a flexibility control apparatus applied thereon according to a first embodiment;

[FIG. 6]

FIG. 6 is a cross-sectional view of an RFID label with the RFID inlay and flexibility control apparatus of FIG. 5, according to the first

embodiment;

[FIG. 7]

FIG. 7 is a top view of an RFID inlay with a flexibility control apparatus applied thereon according to a second embodiment;

[FIG. 8]

FIG. 8 is a cross-sectional view of an RFID label with the RFID inlay and flexibility control apparatus of FIG. 7, according to the second embodiment;

[FIG. 9A]

FIG. 9A is a cross-sectional view of the RFID inlay and flexibility control apparatus of FIG. 5, according to the first embodiment;

[FIG. 9B]

FIG. 9B is a cross-sectional view of the RFID inlay and flexibility control apparatus of FIG. 7, according to the second embodiment;

[FIG. 10A]

FIG. 10A is an illustrative cross-sectional view of the RFID inlay and flexibility control apparatus of FIG. 5, according to the first embodiment, with force applied thereon;

[FIG. 10B]

FIG. 10B is an illustrative cross-sectional view of the RFID inlay and flexibility control apparatus of FIG. 7, according to the second embodiment, with force applied thereon;

[FIG. 11A]

FIG. 11A is an illustrative cross-sectional view of the flexibility control apparatus of FIG. 5, according to a variation of the first embodiment;

[FIG. 11B]

FIG. 11B is an illustrative cross-sectional view of the flexibility control apparatus of FIG. 7, according to a variation of the second embodiment;

[FIG. 12A]

FIG. 12A is an illustrative cross-sectional view of the flexibility control apparatus of FIG. 5, according to a chip-down variation of the first embodiment;

[FIG. 12B]

FIG. 12B is an illustrative cross-sectional view of the flexibility control apparatus of FIG. 7, according to a chip-down variation of the second embodiment;

[FIG. 13A]

FIG. 13A is an illustrative cross-sectional view of the flexibility control apparatus of FIG. 12A, according to another chip-down variation of the first embodiment;

[FIG. 13B]

FIG. 13B is an illustrative cross-sectional view of the flexibility control apparatus of FIG. 12B, according to another chip-down variation of the second embodiment.

[DESCRIPTION OF EMBODIMENTS]

[0024]

The invention will now be described by reference to the preferred embodiments. This does not intend to limit the scope of the present invention but to exemplify the invention. The dimensions of the component in each figure may be changed in order to aid understanding.

The orientation of a component in each figure may be illustrative and may further change in order to aid understanding. Some of the components in each figure may be omitted if they are not important for explanation.

[First embodiment]

[0025]

FIG. 5 shows a top view of an RFID inlay of a flexible RFID label utilizing a flexibility control apparatus according to various embodiments of the invention. An RFID inlay 200 includes, in part, a flexible film-shaped substrate 230. An antenna 210 is disposed on the substrate 230 and formed in a spiral shape. An IC chip 220 is placed on the substrate 230 and electrically connected to the antenna 210 at a connection point 225.

[0026]

A flexibility control apparatus 270 engages with the RFID inlay 200. The flexibility control apparatus 270 consists of a solid layer 272 of a polymer-based material. A preferred first embodiment of the present invention utilizes a flexibility control 270 apparatus made of PET, which is a material that is flexible enough to withstand the force of bending but is able to maintain its shape. The flexibility control apparatus 270 of the first embodiment of the present invention has a middle aperture so as to form an annular, or ring-shaped, solid layer 272, exhibited in FIG. 6. While the current illustration shows a circular-shaped flexibility control apparatus 270, it can be appreciated that the shape of a flexibility control apparatus can be non-circular, e.g., oval-shaped.

[0027]

The flexibility control apparatus 270 of FIG. 5 engages with the RFID inlay 200 with specific consideration to the IC chip 220. First, the solid layer 272 of the flexibility control apparatus 270 must have a greater diameter than the greatest-measured width of the IC chip 220, and the thickness of the solid layer 272 must be equal to or greater than the thickness of the IC chip 220.

[0028]

Second, the alignment of the flexibility control apparatus 270 is such that the IC chip 220 is at or around the center of the solid layer 272 of the flexibility control apparatus 270, according to a top view of the RFID inlay 200. That is, the solid layer 272 of the flexibility control apparatus 270 is positioned to align with the IC chip 220 so that the IC chip 220 is within the outer periphery of the solid layer 272 orthogonal, i.e., when viewed perpendicular, to the surface of the substrate. In the first embodiment, the IC chip 220 is within the aperture of the solid layer 272 of the flexibility control apparatus 270.

[0029]

In the present invention of FIG. 5, an RFID label 280 may be attached to a flexible product 260 in a "chip up" or "chip down" solution. FIG. 6 shows a cross-sectional view of an RFID label 280 utilizing the RFID inlay 200 and flexibility control apparatus 270 of FIG. 5 of the present invention in a "chip up" solution. A top cover 240 similar to that of FIG. 3A and 3B is the top layer of the RFID label 280. For purposes of clarity, the components of the top cover 240, i.e., an adhesive

label 148, an adhesive layer 150a, and/or a cover film 135 are not shown. Like conventional RFID labels, the top cover 240 may be used to convey written information about the product 260 that may also be electronically conveyed by the RFID label 280. The top cover 240 adheres or is bonded to the upside of the RFID inlay 200, which has, on its underside, a layer of adhesive 250a that allows attachment, at least in part, to the flexible product 260. The solid layer 272 of the flexibility control apparatus 270 may be placed within the RFID label 280 such that it is layered in between the RFID inlay 200 and the flexible product 260.

[Second embodiment]

[0030]

FIG. 7 shows a top view of an RFID inlay of a flexible RFID label 380 utilizing a flexibility control apparatus 370 according to a preferred second embodiment of the invention. The RFID inlay 300 includes a substrate 330, antenna 310, and IC chip 320 similar to that of the first embodiment. Like the first embodiment, an RFID label 380 may be attached to a flexible product 260 in a "chip up" or "chip down" solution.

[0031]

A flexibility control apparatus 370 engages with the RFID inlay 300, the flexibility control apparatus 370 also consisting of a solid layer 372, shown in FIG. 8, of a polymer-based material, such as PET, similar to the first embodiment. In the second embodiment, the flexibility control apparatus 370 does not include an aperture but instead is formed as a disk-shaped solid layer 372. While the current illustration

shows a circular-shaped disk of a flexibility control apparatus 370, it can be appreciated that the shape of a flexibility control apparatus 370 can be a non-circular, e.g., oval-shaped, disk.

[0032]

The flexibility control apparatus 370 of FIG. 7 engages with the RFID inlay 300 similar to the first embodiment, with specific consideration of its placement with relation to the IC chip 320. The disk-like solid layer 372 of the flexibility control apparatus 370 must also have a diameter greater than the greatest-measured width of the IC chip 320, and the thickness of the solid layer 372 must be equal to or greater than the thickness of the IC chip 320. The alignment of the flexibility control apparatus 370 is such that the IC chip 320 is at or around the center of the solid layer 372 of the flexibility control apparatus 370, according to a top view of the RFID inlay 300. That is, the disk-like solid layer 372 of the flexibility control apparatus 370 is positioned to align with the IC chip 320 so that the IC chip 320 is within the outer periphery of the solid layer 372 orthogonal, i.e., when viewed perpendicular, to the surface of the substrate 330. In the second embodiment, the flexibility control apparatus 370 has no aperture, so that the position of the solid layer 372 of the flexibility control apparatus 370 with respect to the IC chip 320 is not as strict.

[0033]

FIG. 8 shows a cross-sectional view of an RFID label 380 utilizing the RFID inlay 300 and flexibility control apparatus 370 of FIG. 7 of the present invention. Like the first embodiment of the present invention, an RFID label 380 of the second embodiment may be attached

to a flexible product 360. The RFID label 380 may have, on its upper surface, a top cover 340, which may include an adhesive label, adhesive layer, and/or cover film (not shown). The top cover 340 relates to the flexible product 360 such that the RFID inlay 300 of the RFID label 380 is positioned between the product 360 and the top cover 340. A layer of adhesive 350 attaches the RFID inlay 300 to the flexible product 360. The disk-shaped solid layer 372 of the flexibility control apparatus 370 may be placed within the RFID label 380 such that it is in between the RFID inlay 300 and the flexible product 360.

[0034]

FIG. 9A and FIG. 9B are sectional cross-section views showing the RFID inlay 200, 300 engaging with the flexibility control portion 270, 370 in a "resting" state, where no outside force is being applied to the RFID label 280, 380 and consequently the RFID inlay 200, 300. In this particular state, shown as "chip up", the flexibility control portion 270, 370 is attached to the RFID inlay 200, 300 with no bend in either the inlay or the portion.

[0035]

FIG. 10A and FIG. 10B are sectional cross-section views showing the RFID inlay 200, 300 engaging with the flexibility control portion 270, 370 in an "active" state where outside force is applied to the RFID label 280, 380. In the active state, the flexible substrate 230, 330 and the attached antenna 210, 310 bend with the force applied thereon. In a conventional system, the RFID inlay would be damaged due to a weakened connection point between the IC chip and the antenna. However, in the present invention, the flexibility control apparatus 270, 370

allows for the RFID inlay 200, 300 to bend but not at the location of the IC chip 220, 320. This is, in part, because the flexible material of the substrate 230, 330 is reinforced with the same or similar material through the solid layer 272, 372 of the flexibility control apparatus 270, 370, but only within the periphery of the IC chip 220, 320. Thus, bending becomes localized to only the area around the IC chip 220, 320, allowing for a flexible product and manipulation of the RFID label, but protection of the RFID inlay and the IC chip.

[0036]

The flexibility control apparatus 270, 370 of the first and second embodiments controls the bend of the RFID label 280, 380 ideally when the solid layer is circular, as edge of the flexibility control apparatus 270, 370 is uniformly even and avoids disengagement from the RFID inlay 200, 300.

[0037]

FIGS. 11A and 11B are cross-sectional views of a variation of the first and second embodiments, respectively, of the RFID label 280, 380. In the first and second embodiments, as shown from FIG. 6 and FIG. 8, an adhesive layer 250a, 350a engages with the underside of the RFID inlay 200, 300 such that the adhesive layer 250a, 350a is on the undersurface of the RFID inlay 200, 300 and the flexibility control apparatus 270, 370 is further attached to the undersurface of the adhesive layer 250a, 350a. In a variation of the first and second embodiments, the flexibility control apparatus 270, 370 is layered in between the RFID inlay 200, 300 and the adhesive layer 250a, 350a. Therefore, this variation of the first and second embodiment realizes

the flexibility control apparatus 270, 370 more closely attached to the RFID inlay 200, 300 and further realizes a full attachment of the adhesive layer 250a, 350a to the flexible product 260, 360.

[0038]

The illustrations of FIG. 5 to FIG. 11B show that the flexibility control apparatus 270, 370 engages with the "bottom surface", e.g., a substrate 230, 330 of the RFID inlay 200, 300 that is "chip up." That is, the chip is located on the upper surface of the substrate with respect to the RFID label 280, 380 orientation with respect to the flexible product 260, 360. It can be appreciated by those skilled in the art that a flexibility control apparatus may engage with an RFID inlay in a "chip down" scenario or be attached to a "top surface" of the RFID inlay. FIG. 12A and FIG. 12B illustrate a cross-sectional view of an RFID label 480, 580 utilizing a "chip down" RFID inlay 400 and how the flexibility control apparatus 470 engages therewith. Similar to that of the "chip up" solution, the RFID label 480, 580 includes a top cover 440, 540, which may include an adhesive label, adhesive layer, and/or a cover film; an RFID inlay 400, 500, which includes an IC chip 420, 520 connected at a connection point 425, 525 to an antenna 410, 510 on a substrate 430, 530; and an adhesive layer 450a, 550a that engages with a flexible product 460, 560. However, in the embodiment of a "chip down" solution, the substrate 430, 530 and antenna 410, 510 are layered above the IC chip 420, 520 in the RFID label laminate. A flexibility control apparatus 470, 570 of the first and second embodiment, respectively, is placed in between the top cover 440, 540 and the substrate 430, 530 of the RFID inlay 400,

500.

[0039]

Similarly, FIG. 13A and FIG. 13B show a "chip down" solution of an RFID label 480, 580. However, in the present variation, the flexibility control apparatus 470, 570 is located on the upper side of the top cover 440, 540. This variation allows flexibility of manufacture of the RFID label 480, 580, as the flexibility control apparatus 470, 570 may be placed on the top cover 440, 540.

[0040]

It can be noted that the flexibility control apparatus 270, 370, 470, 570 of the first and second embodiment may not only include a solid layer 272, 372, 472, 572 but may also include of any combination of a solid layer 272, 372, 472, 572 and a layer of adhesive separate from that of the adhesive layers 250a, 350a, 450a, 550a of the RFID label 280, 380, 480, 580.

[0041]

For example, in another variation of the first embodiment, an upper adhesive layer (or "top adhesive layer") that is ring-shaped, may be positioned above a solid layer oriented with respect to a flexible product. In addition to an upper adhesive layer, a ring-shaped lower adhesive layer (or "bottom adhesive layer") may be introduced, which is positioned below the solid layer oriented with respect to the flexible product. Both an upper and lower adhesive layer may be made of an adhesive, such as tape, and may attach the solid layer individually to the RFID inlay or to the flexible product, respectively. Both the upper adhesive layer and the lower adhesive layer of a

flexibility control apparatus may be made to be the same thickness as the solid layer. Further, both the upper adhesive layer and the lower adhesive layer may have an aperture that matches or is of similar size to that of the solid layer, such that the inner diameter and outer diameter of the upper adhesive layer and lower adhesive layer may be realized to be the same as the inner diameter and the outer diameter of the solid layer. The upper adhesive layer and the lower adhesive layer may be aligned with the solid layer. As such, it can be appreciated that the IC chip may be positioned within the aperture of both adhesive layers and the solid layer orthogonal to the substrate in another variation of the first embodiment.

[0042]

Similarly, in an alternative variation of the second embodiment, one or more adhesive layers are realized for the flexibility control apparatus. The flexibility control apparatus may comprise a solid layer and a disk-shaped upper adhesive layer, which is positioned above and aligned with the disk-shaped solid layer oriented with respect to the flexible product. Alternatively, the flexibility control apparatus may comprise a solid layer and an upper adhesive layer that is ring shaped, similar to that of the above variation of the first embodiment. The upper adhesive layer of the variation of the second embodiment may also attach to either the adhesive layer or to the RFID inlay itself. In addition, the flexibility control apparatus may comprise a disk-shaped a lower adhesive layer positioned below the solid layer. The lower adhesive layer may attach the flexibility control apparatus to the flexible product or the adhesive layer,

depending where the flexibility control apparatus is positioned. The adhesive layers of the variation of the second embodiment may be similar to that of the variation of the first embodiment in terms of thickness, diameter, and alignment. It can be appreciated by those skilled in the art that adding one or more adhesive layers to the flexibility control apparatus will allow it to be secured more firmly to the RFID label and to the flexible product on which the RFID label is attached.

[0043]

The present embodiments describe an RFID label that uses one flexibility control apparatus. However, it can be appreciated by those skilled in the art that the number of flexibility control apparatuses that are contained on or within the RFID label may be greater than one.

[0044]

It will be understood to a skilled person that the functions achieved by the constituting elements recited in the claims are implemented either alone or in combination by the constituting elements shown in the embodiments and their variations.

[INDUSTRIAL APPLICABILITY]

[0045]

The present invention can be used in the field of RFID tag detection and transmission and for use with RFID systems and systems necessitating the use of an RFID label, and the medical device industry.

[CLAIMS]

[Claim 1]

A flexible RFID label adapted to be attached to an object of flexible structure, the flexible RFID label comprising:

an RFID inlay having a flexible film-shaped substrate, an antenna disposed on the flexible film shaped substrate, and an integrated circuit (IC) chip electrically connected to the antenna;

an adhesive layer adapted to attach the RFID inlay to an object of flexible structure; and

at least one flexibility control apparatus having a solid layer adapted to engage with the RFID inlay,

wherein the solid layer is positioned to align with the integrated circuit (IC) chip and dimensioned such that the integrated circuit (IC) chip is within an outer periphery of the solid layer when viewed perpendicular to the surface of the substrate.

[Claim 2]

The flexible RFID label of claim 1, wherein the solid layer is a polymer-based solid layer.

[Claim 3]

The flexible RFID label of claim 1-2, further comprising a cover layer that is applied to cover the RFID inlay, wherein the RFID inlay is laminated between the cover layer and the adhesive layer.

[Claim 4]

The flexible RFID label of claim 3, wherein the solid layer is applied to the opposite side of the substrate compared with the integrated circuit (IC) chip.

[Claim 5]

The flexible RFID label of claim 4, wherein the cover layer is on the same side of the substrate as the integrated circuit (IC) chip.

[Claim 6]

The flexible RFID label of claim 4, wherein the cover layer is on the opposite side of the substrate when compared with the integrated circuit (IC) chip.

[Claim 7]

The flexible RFID label of claim 5, wherein the solid layer is applied between the adhesive layer and the substrate.

[Claim 8]

The flexible RFID label of claim 5, wherein the solid layer is applied below the adhesive layer, wherein the adhesive layer is between the solid layer and the substrate.

[Claim 9]

The flexible RFID label of claim 6, wherein the solid layer is applied between the cover layer and the substrate.

[Claim 10]

The flexible RFID label of claim 6, wherein the solid layer is applied above the cover layer, wherein the cover layer is between the solid layer and the substrate.

[Claim 11]

The flexible RFID label of claims 7 and 8, wherein the adhesive layer engages the solid layer with the RFID inlay.

[Claim 12]

The flexible RFID label of claims 9 and 10, wherein an additional

adhesive layer engages the solid layer with the RFID inlay.

[Claim 13]

The flexible RFID label of claim 1-12, wherein the solid layer is aligned such that the integrated circuit (IC) chip is at or around an axial center of the solid layer and an outer diameter of the solid layer is dimensioned to overlap the integrated circuit (IC) chip.

[Claim 14]

The flexible RFID label of claim 1-12, wherein the solid layer has an aperture, and the solid layer is dimensioned and positioned such that the integrated circuit (IC) chip is within the aperture of the solid layer when viewed perpendicular to the surface of the substrate.

[Claim 15]

The flexible RFID label of claim 14, wherein the solid layer is of a ring shape.

[Claim 16]

The flexible RFID label of claim 1-15, wherein a thickness of the solid layer is greater than or equal to a thickness of the integrated circuit (IC) chip.

[Claim 17]

The flexible RFID label of claim 1-16, wherein the solid layer is made of polyethylene terephthalate (PET).

[Claim 18]

The flexible RFID label of claim 14, wherein a major surface of the solid layer overlaps with the IC chip when viewed perpendicular to the surface of the substrate.

[Claim 19]

The flexible RFID label of claim 14, wherein the solid layer is of a circular shape.

[Claim 20]

The flexible RFID label of claim 3, wherein the cover layer is used to convey information.

[Claim 21]

The flexible RFID label of claim 3, further comprising an upper label conveying information, the upper label applied on the cover layer.

[Claim 22]

The flexible RFID label of claim 1-21, wherein the object of flexible structure is a product of flexible structure that retains general shape.

[Claim 23]

The flexible RFID label of claim 1-22, wherein the object of flexible structure is a blood bag or a blood product bag.

[Claim 24]

A flexibility control apparatus, comprising:

a polymer resin-based solid layer that engages with a RFID inlay, the RFID inlay having an integrated circuit (IC) chip disposed on an upper surface of the substrate, and an antenna electrically connected to the integrated circuit (IC) chip,

wherein the solid layer that engages with the RFID inlay is arranged on an opposite side of the integrated circuit (IC) chip with respect to the substrate, and wherein the solid layer is aligned with the integrated circuit (IC) chip and dimensioned such that the integrated circuit (IC) chip is positioned within an outer periphery of the solid layer when viewed perpendicular to the surface of the substrate.

[Claim 25]

The flexibility control apparatus of claim 24, further comprising an adhesive layer, which includes an adhesive, applied to the under surface of the substrate adapted to adhere to an object of flexible structure.

[Claim 26]

The flexibility control apparatus of claim 25, wherein the solid layer is applied on the adhesive layer such that the solid layer is engaged with the substrate to control flexibility of the substrate.

[Claim 27]

The flexibility control apparatus of claim 24-26, wherein a major surface of the solid layer overlaps with the integrated circuit (IC) chip when viewed perpendicular to the surface of the substrate.

[Claim 28]

The flexibility control apparatus of claim 24-27, wherein the solid layer is of a circular shape.

[Claim 29]

The flexibility control apparatus of claim 24-28, wherein the solid layer is aligned such that the integrated circuit (IC) chip is at or around an axial center of the solid layer and an outer diameter of the solid layer is dimensioned to overlap the integrated circuit (IC) chip.

[Claim 30]

The flexibility control apparatus of claim 24-28, wherein the solid layer has an aperture, the solid layer is dimensioned such that the integrated circuit (IC) chip is positioned within the aperture of the

solid layer when viewed perpendicular to the surface of the substrate.

[Claim 31]

The flexibility control apparatus of claim 30, wherein the solid layer is of a ring shape.

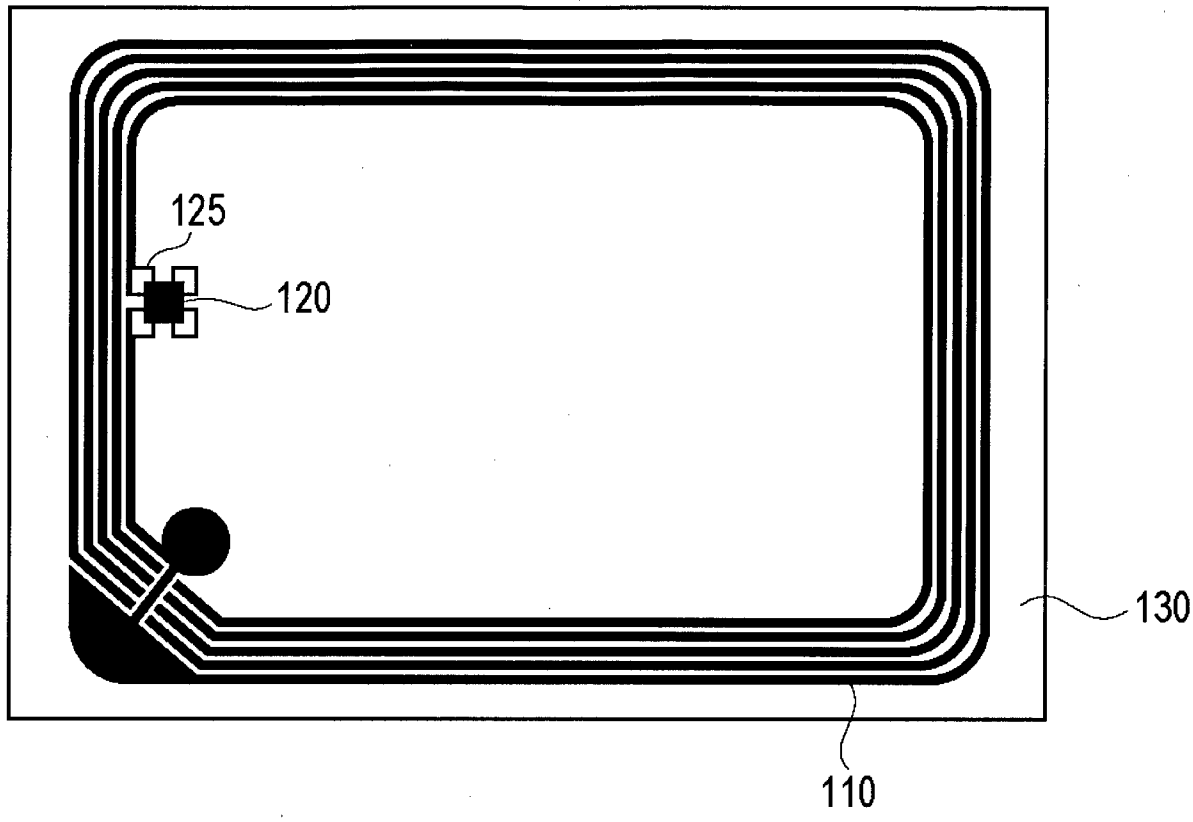
[Claim 32]

The flexibility control apparatus of claim 24-31, wherein a thickness of the solid layer is greater than or equal to a thickness of the integrated circuit (IC) chip.

[Claim 33]

The flexibility control apparatus of claim 24-32, wherein the solid layer is made of polyethylene terephthalate (PET).

[Fig. 1]



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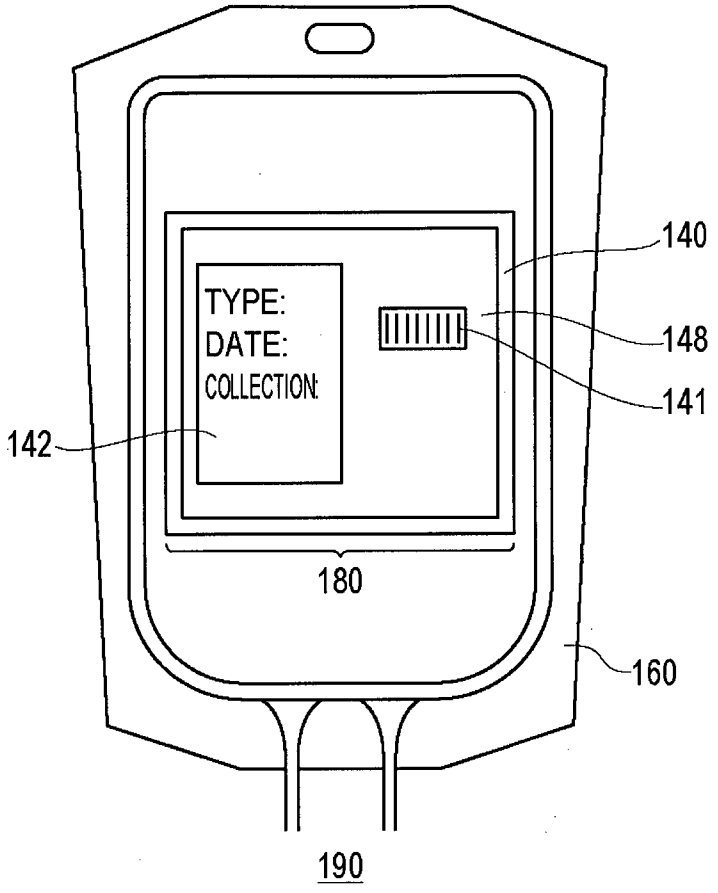
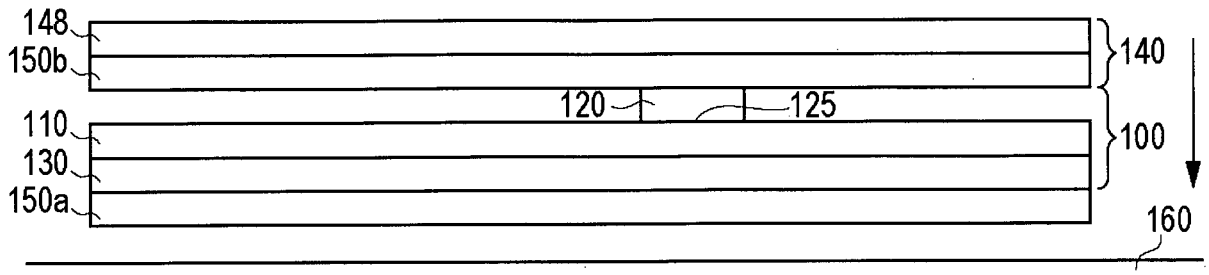
[Fig. 2]



[Fig. 3A]



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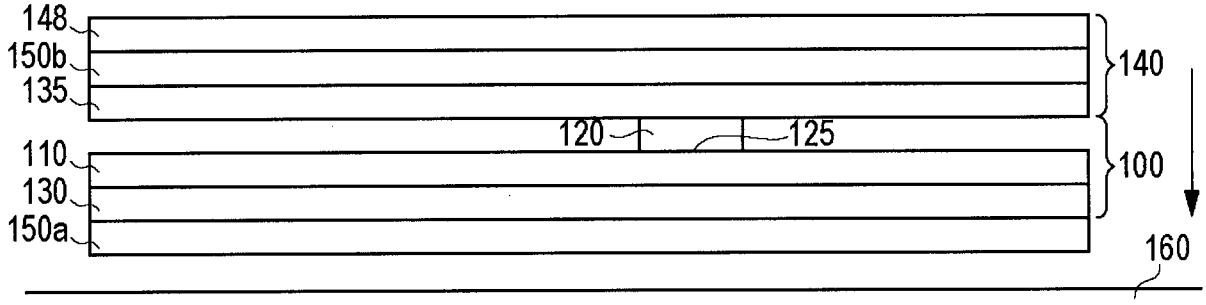
[Fig. 3B]



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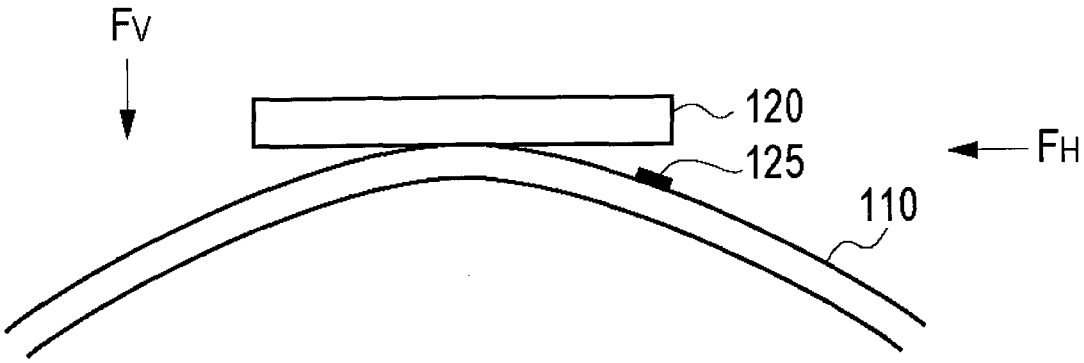
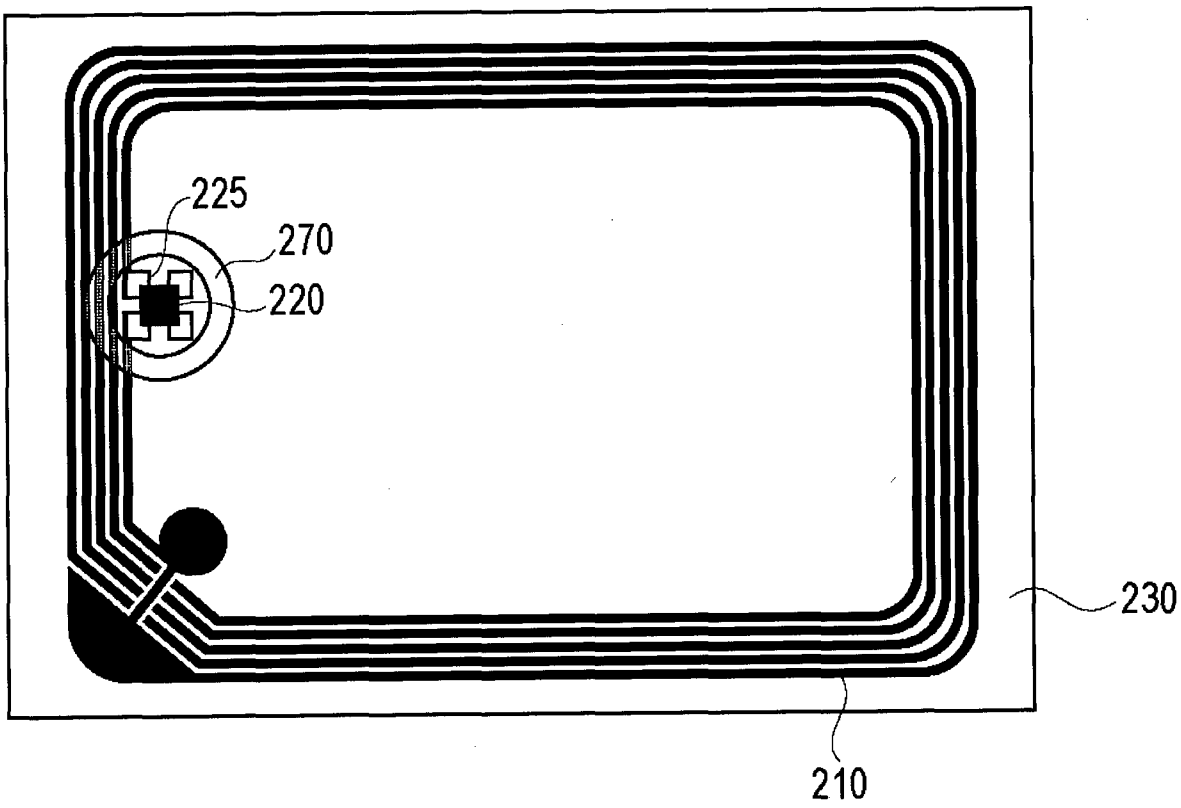
[Fig. 4]



[Fig. 5]



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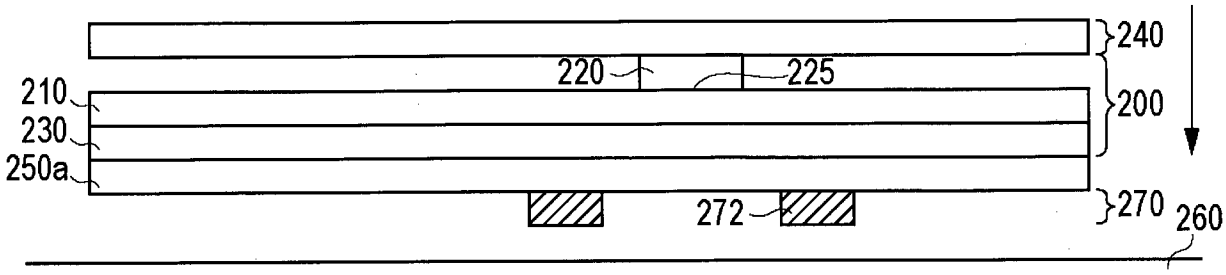
[Fig. 6]



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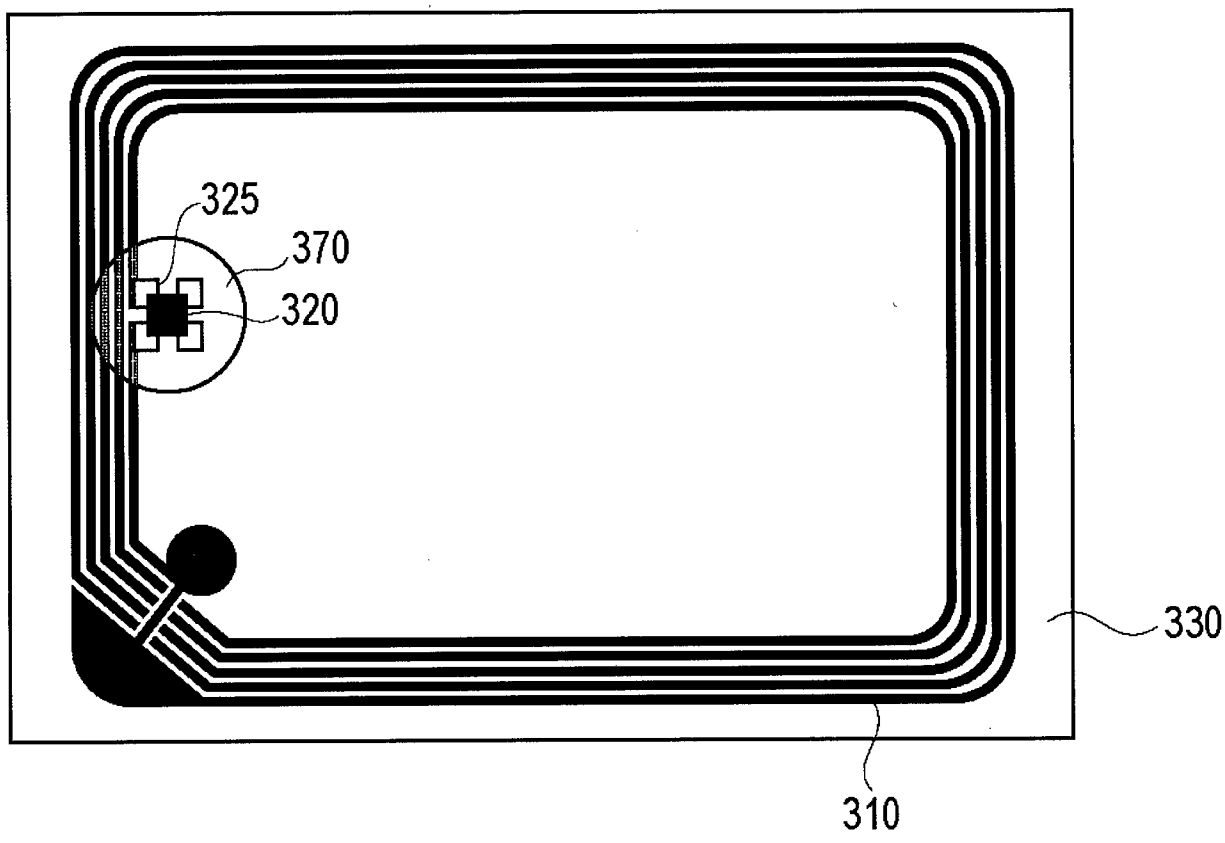
[Fig. 7]



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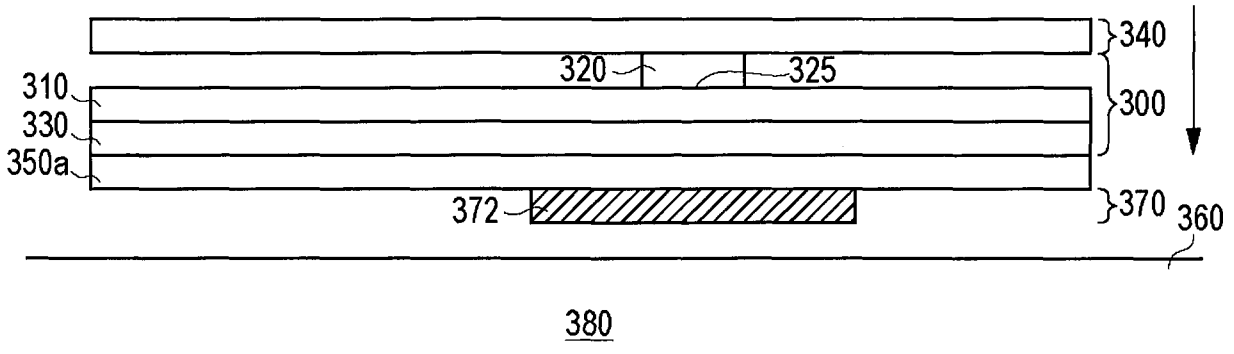
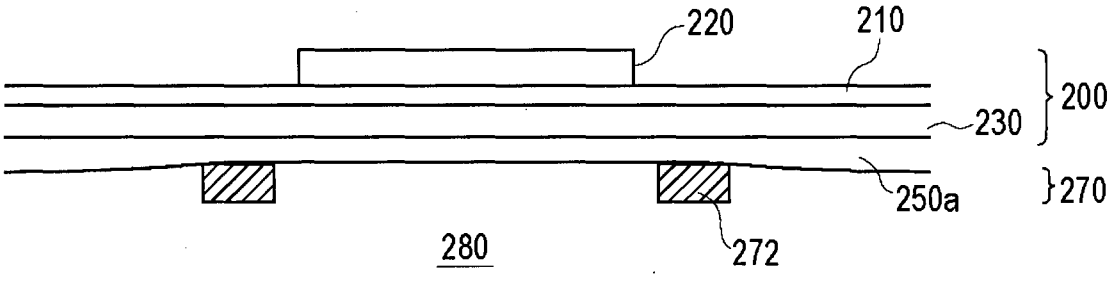
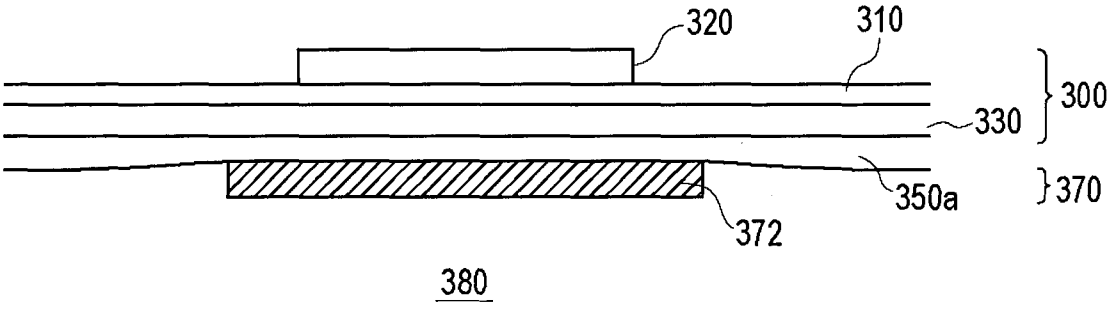
[Fig. 8]



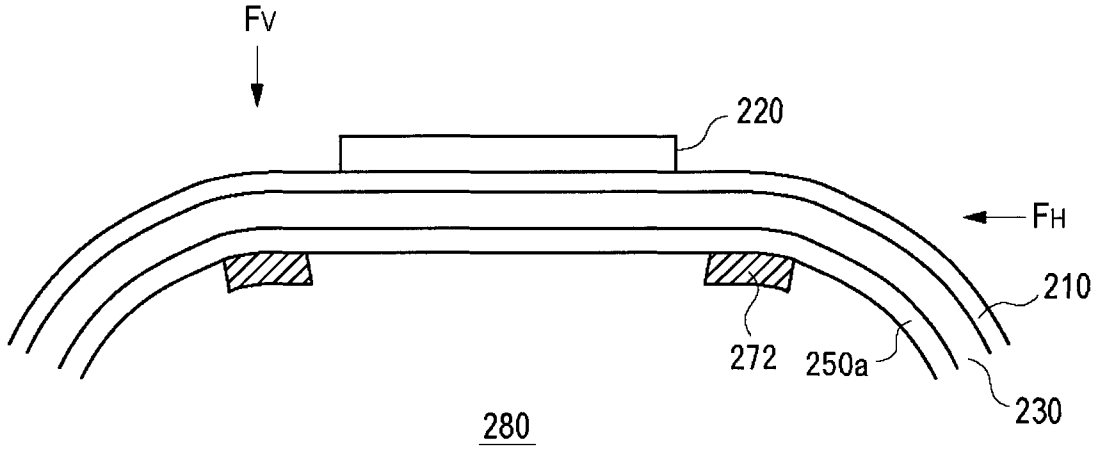
[Fig. 9A]



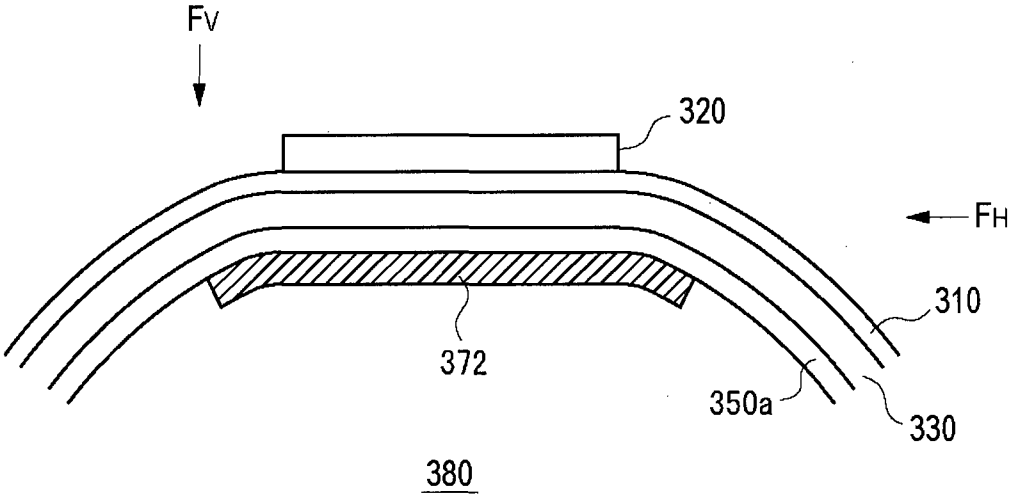
[Fig. 9B]



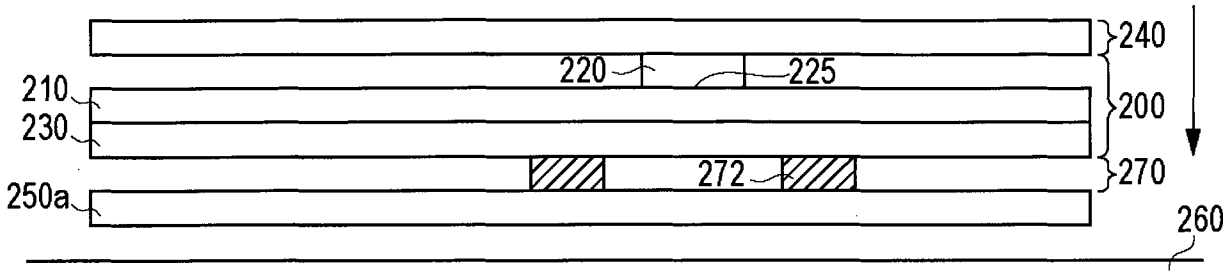
[Fig. 10A]



[Fig. 10B]



[Fig. 11A]



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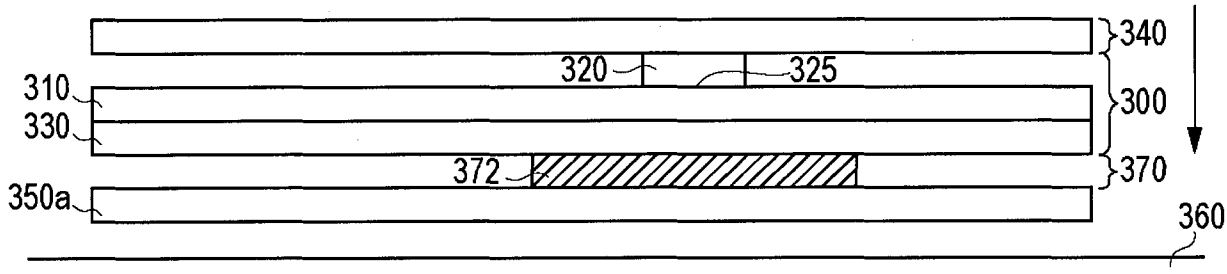
[Fig. 11B]



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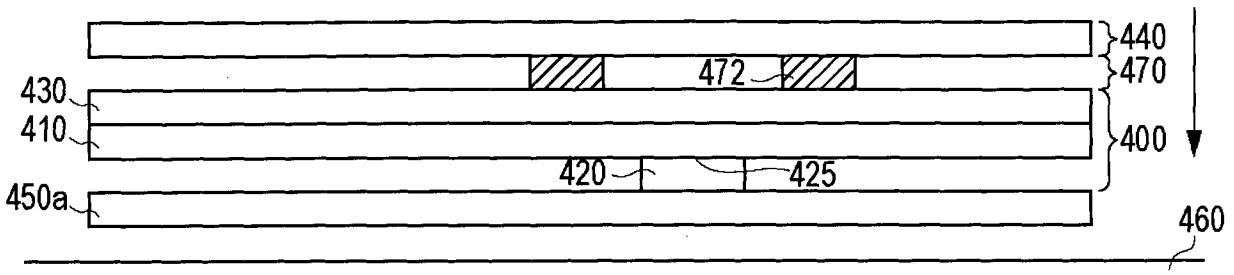
[Fig. 12A]



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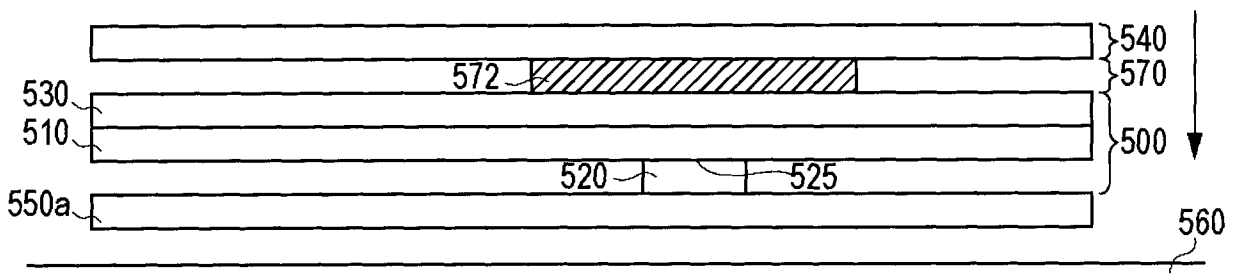
[Fig. 12B]



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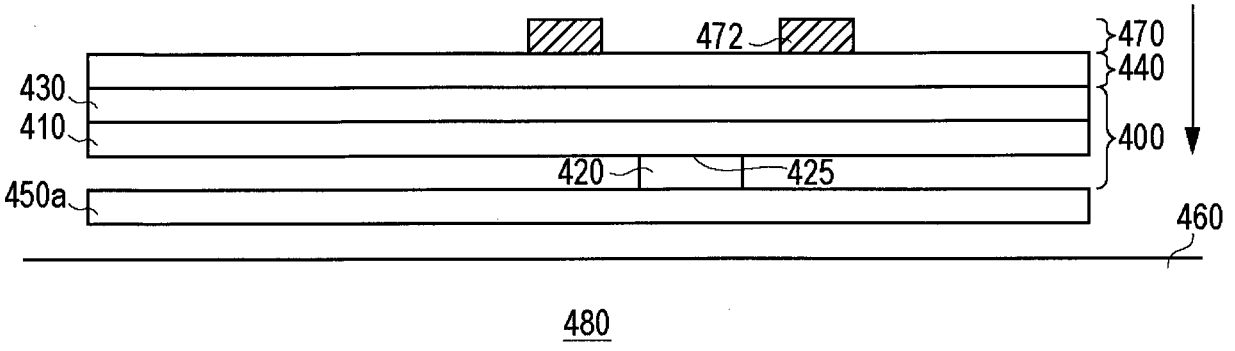
[Fig. 13A]



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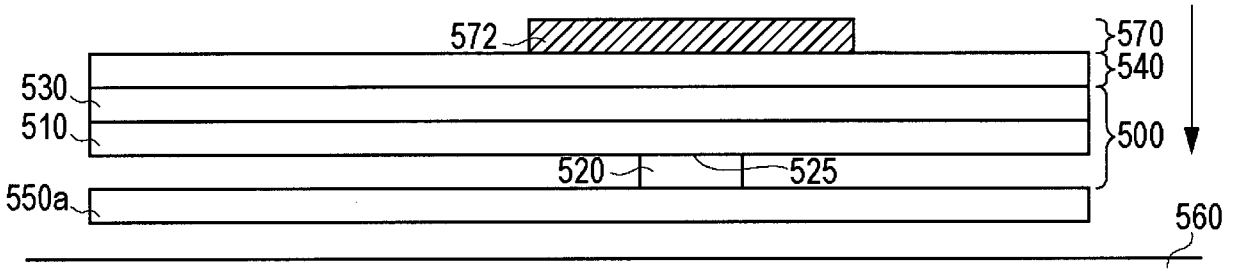
[Fig. 13B]



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/070463

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. G06K19/077(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. G06K19/077

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2015
Registered utility model specifications of Japan 1996-2015
Published registered utility model applications of Japan 1994-2015

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2003-196631 A (TOPPAN FORMS CO., LTD) 2003.07.11,paragraphs[0001],[0009],[0014]-[0023],Fig.2 (No Family)	1-3,20-21 4-7,9-19,22-33 8
Y A	JP 2013-30069 A (TOPPAN PRINTING CO., LTD) 2013.02.07, paragraph[0042],Fig.5 (No Family)	4-7,9-19,22-33 8
Y A	JP 2013-73574 A (TOPPAN FORMS CO., LTD) 2013.04.22, paragraphs[0047]-[0051],Fig.4 (No Family)	7,11-19,22-23,25-33 8

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03.08.2015	11.08.2015

Name and mailing address of the ISA/JP	Authorized officer
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5N 4677